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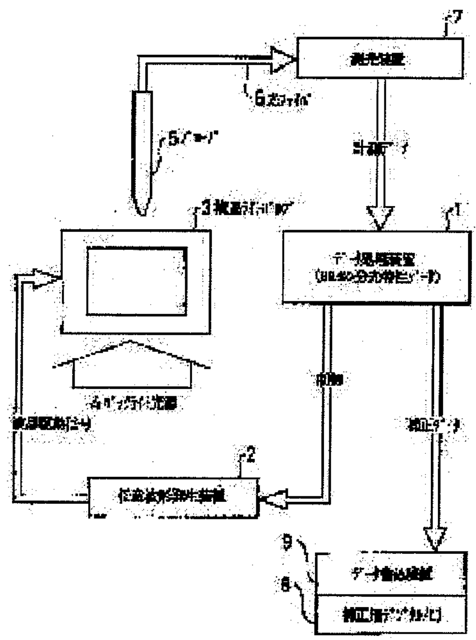
(54) GRADATION CORRECTING INFORMATION GENERATING SYSTEM FOR LIQUID CRYSTAL LIGHT VALVE

(57)Abstract:
PURPOSE: To provide a system capable of efficiently generating the gradation correcting information according to the applied voltage transmissivity characteristic of a liquid crystal light valve at a high speed.
CONSTITUTION: By a data processor 1, the generation of a test signal is indicated to an optional waveform generator 2 in the state that a light source 4 lights the liquid crystal valve 3. Thus, the test signal is generated by the optional waveform generator 2 to be imparted to the light valve 3, and the transmissivity is revised. At this time, the transmissivity is measured by a photometry device 7. By the data processor I, the applied voltage - transmissivity characteristic of the liquid crystal light valve 3 is caught from the indicated test signal and a transmissivity signal, and the gradation correcting information is generated.



CLAIMS

[Claim(s)]
[Claim 1]A gray-level-correction information preparing system of a liquid crystal light valve which creates gray-level-correction information which makes linear relation the gradation characteristic of a liquid crystal light valve characterized by comprising the following.

A light source which illuminates the above-mentioned liquid crystal light valve.
A test signal generating means which generates a test signal over the above-mentioned liquid crystal light valve.
A photometry means which receives a beam of light which penetrated the above-mentioned liquid crystal light valve, and outputs a transmittance signal.
A data processing means which catches the impressed-electromotive-force-transmissivity characteristic of the above-mentioned liquid crystal light valve based on a transmittance signal which generating of a test signal is directed to the above-mentioned test signal generating means, and is then given from a photometry means, and creates gray-level-correction information.

[Claim 2]The above-mentioned data processing means generates a test signal using once acquired gray-level-correction information from the above-mentioned test signal generating means, The validity of gray-level-correction information is judged based on a transmittance signal from the above-mentioned photometry means, A gray-level-correction information preparing system of the liquid crystal light valve according to claim 1 acquiring eventually gray-level-correction information which repeats validity judgment corrects gray-level-correction information and a test signal is generated [judgment / make] again in not being appropriate, and makes linear relation the gradation characteristic of the above-mentioned liquid crystal light valve.
[Claim 3]A gray-level-correction information preparing system of the liquid crystal light valve according to claim 1 or 2 making gray-level-correction information which was provided with a digital memory for storing of gray-level-correction information, and from which the above-mentioned data processing means was acquired to this digital memory store.
[Claim 4]An arbitrary waveform generating part which generates arbitrary wave-like signals [generating means / above-mentioned / test signal] according to a command signal from the above-mentioned data processing means, A digital memory for storing of gray-level-correction information, A gray-level-correction information preparing system of the liquid crystal light valve according to claim 1 or 2 comprising a liquid crystal actuator which drives an account liquid crystal light valve of Gokami which amended a signal from the above-mentioned arbitrary waveform generating part using gray-level-correction information stored in the above-mentioned digital memory.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to the system which creates the gray-level-correction information on a liquid crystal light valve (for example, impressed-electromotive-force-transmissivity correction information).

[0002]
[Description of the Prior Art]considering a video signal and transmissivity (translucent rate) of light as a linearity relation in a liquid crystal display -- the linear gradation of a video signal -- a sex is maintained and display image quality of a video signal can be made suitable. However, the liquid crystal light valve in a active-matrix type liquid crystal panel does not have impressed electromotive force and transmissivity in a linearity relation. Then, according to the impressed-electromotive-force-transmissivity characteristic of a liquid crystal light valve, a video signal is amended beforehand, and it requires making it the video signal and transmissivity before amendment become a linearity relation. Below, suppose that such amendment is called impressed-electromotive-force-transmissivity amendment.
[0003]In the imaging system, amendment (what is called gamma correction) of 1/gamma power has been performed to the video signal on the assumption that the cathode-ray tube (that is, light emitting luminance and input voltage are nonlinear) with which it is a display system and light emitting luminance is proportional to gamma ** of input voltage is applied. However, since gamma correction is against a cathode-ray tube, in a liquid crystal display, gamma correction is unnecessary. Then, in a liquid crystal display, it is made to perform reverse correction (it is hereafter called inverse gamma correction) to the gamma correction performed by the imaging system to a video signal.
[0004]Conventionally, the function generating circuit of analog circuitry composition was used as an impressed-electromotive-force-transmissivity correction circuit. The function generating circuit of the analog circuitry composition also as an inverse-gamma-correction circuit was used. He establishes an impressed-electromotive-force-transmissivity correction circuit in the latter part of an inverse-gamma-correction circuit, and is trying for impressed-electromotive-force-transmissivity amendment to receive only an impressed-electromotive-force-transmissivity characteristic only to gamma correction in practice in inverse gamma correction.
[0005]However, the impressed-electromotive-force-transmissivity characteristic of a liquid crystal light valve is expressed with one function using the combination of three or more curves and a straight line, even if expressing has a difficult curve and it approximates. Therefore, it is difficult for the correction circuit which performs impressed-electromotive-force-transmissivity amendment to become complicated, and for a correction curve to also obtain a suitable thing to an impressed-electromotive-force-transmissivity characteristic. The correction curve called for theoretically has steep shape, in such a steep shaped part, naturally output voltage changes a lot to the slight difference in input voltage, and there is a problem that a thing suitable as above correction curves is difficult to get. Therefore, according to the correcting method using the conventional analog circuitry, impressed-electromotive-force-transmissivity amendment was insufficient and display image quality was reduced.
[0006]On the other hand, an inverse-gamma-correction curve can be expressed with one function. However, since the shape was nonlinear shape even if it can express with one function, it was difficult to realize appropriately in the function generating circuit of analog circuitry composition, and it had arisen that inverse gamma correction fully performs and does not go out as well as ****.
[0007]Thus, both amendments to the gradation of a video signal were insufficient, and more than the video signal with which both amendments were performed compounded the insufficient degree by each amendment, it became unsuitable and was not able to avoid big deterioration of display image quality by the former.
[0008]Then, the thing for which the same applicant performs impressed-electromotive-force-transmissivity amendment using a translation table, Performing inverse gamma correction using a translation table, performing amendment which compounded impressed-electromotive-force-transmissivity amendment and inverse gamma correction using one translation table, etc. are already proposed (the Japanese-Patent-Application-No. No. 408806 [two to] specification, and a drawing).
[0009]Here, an inverse-gamma-correction curve becomes settled uniquely not related in the kind of liquid crystal light valve. On the other hand, the synthetic curve of an impressed-electromotive-force-transmissivity correction curve, and an impressed-electromotive-force-

transmissivity correction curve and an inverse-gamma-correction curve changes with kinds of liquid crystal light valve.
Even if it is an identical kind, it changes delicately also with each products of a liquid crystal light valve.

[0010]Therefore, when performing impressed-electromotive-force-transmissivity amendment using a translation table, or in performing amendment which compounded impressed-electromotive-force-transmissivity amendment and inverse gamma correction using one translation table. For every product kind or every (every [or] lot) product, the impressed-electromotive-force-transmissivity characteristic of the liquid crystal light valve was measured, it asked for the correction curve, amendment data was calculated, and the translation table was created.
[0011]
[Problem(s) to be Solved by the Invention]However, operation which creates the amendment data which follows a correction curve from the impressed-electromotive-force-transmissivity characteristic which measures an impressed-electromotive-force-transmissivity characteristic, and which was acquired by operation is performed, and even if it obtained amendment data, the operation mentioned above for the check is once repeated. Therefore, by the time it obtained final amendment data, complicated operation was required, and time was also this thing. Here, even if it uses software processing for the operation which obtains amendment data from the acquired impressed-electromotive-force-transmissivity characteristic, it takes much time and effort and time. Therefore, what creates amendment data for every product was impossible in practice.
[0012]This invention is made in consideration of the above point, and tends to provide the gray-level-correction information preparing system of the liquid crystal light valve which can create efficiently the gray-level-correction information according to the impressed-electromotive-force-transmissivity characteristic of the liquid crystal light valve in a short time.
[0013]
[Means for Solving the Problem]In [in order to solve this technical problem] this invention, A light source which illuminates a liquid crystal light valve, and a test signal generating means which generates a test signal over a liquid crystal light valve, A photometry means which receives a beam of light which penetrated a liquid crystal light valve, and outputs a transmittance signal, By a data processing means which generating of a test signal is directed to a test signal generating means, and catches the impressed-electromotive-force-transmissivity characteristic of a liquid crystal light valve based on a transmittance signal then given from a photometry means, and creates gray-level-correction information. A gray-level-correction information preparing system of a liquid crystal light valve which creates gray-level-correction information which makes linear relation the gradation characteristic of a liquid crystal light valve was constituted.
[0014]The above-mentioned data processing means generates a test signal using once acquired gray-level-correction information from a test signal generating means here, It is preferred to acquire eventually gray-level-correction information which judges the validity of gray-level-correction information, repeats validity judgment which corrects gray-level-correction information and generates [make] a test signal again based on a transmittance signal from a photometry means in not being appropriate, and makes linear relation the gradation characteristic of a liquid crystal light valve.
[0015]It is preferred to make gray-level-correction information which was provided with a digital memory for storing of gray-level-correction information, and a data processing means created to this digital memory store.
[0016]An arbitrary waveform generating part which generates arbitrary wave-like signals [generating means / test signal] according to a command signal from a data processing means, It is preferred to comprise a digital memory for storing of gray-level-correction information and a liquid crystal actuator which drives a liquid crystal light valve after gray-level-correction information stored in a digital memory amends a signal from the above-mentioned arbitrary

waveform generating part. In this case, naturally it is unnecessary to provide a digital memory which exacts and stores created gray-level-correction information.
[0017]
[Function]In the gray-level-correction information preparing system of the liquid crystal light valve of this invention, in the state where the light source is illuminating the liquid crystal light valve, a data processing means, It points to generating of a test signal to a test signal generating means, and thereby, a test signal generating means generates a test signal, gives a liquid crystal light valve, and makes transmissivity change. At this time, a photometry means measures transmissivity and gives a transmittance signal to a data processing means. A data processing means catches the impressed-electromotive-force-transmissivity characteristic of a liquid crystal light valve from the test signal and transmittance signal to which it pointed, and creates gray-level-correction information. Thus, the system which can create gray-level-correction information efficiently in a short time is realizable.
[0018]It is desirable to check whether the created gray-level-correction information is appropriate here. Then, it is preferred that judge the validity of gray-level-correction information, generate the test signal using the once acquired gray-level-correction information from a test signal generating means, a data processing means corrects gray-level-correction information based on the transmittance signal from a photometry means in not being appropriate, and it repeats validity judgment.
[0019]It is desirable to also perform operation which stores in its digital memory [like] the gray-level-correction information which the system concerned created.
[0020]The arbitrary waveform generating part which generates the arbitrary wave-like signals [generating means / test signal] according to the command signal from a data processing means, If constituted from a digital memory for storing of gray-level-correction information, and a liquid crystal actuator which drives a liquid crystal light valve after the gray-level-correction information stored in the digital memory amends the signal from the above-mentioned arbitrary waveform generating part, An impressed-electromotive-force-transmissivity characteristic can be measured in the state where it was based on the actual liquid crystal display.
[0021]
[Example]
(1) Explain the 1st less than example and the 1st example of this invention in full detail, referring to drawings. This 1st example is related with the system which measures an impressed-electromotive-force-transmissivity characteristic in the state where the liquid crystal driving circuit is not incorporated to the liquid crystal light valve, and creates amendment data.
[0022](1-1) The lineblock diagram 1 of the 1st example is a block diagram showing the entire configuration of this 1st example system. The data processing device 1 controls the whole system concerned according to the processing shown in drawing 2 mentioned later, and makes amendment data write in the digital memory (ROM) for amendment which constitutes a translation table eventually in drawing 1. The data processing device 1 is controlled to make an arbitrary waveform voltage signal (test signal) output to the arbitrary waveform generator 2, when checking the time of measurement of an impressed-electromotive-force-transmissivity characteristic, and the once created linearity of amendment data. The arbitrary waveform generator 2 generates the arbitrary waveform voltage signal (it corresponds to a video signal) centering on the command voltage by the data processing device 1, and gives it to the liquid crystal light valve 3 by making this into a liquid crystal driving signal.
[0023]That in which the direction of X and the direction of Y short-circuited is used for the liquid crystal light valve 3 in this example. That is, all the cells use what is simultaneously switched according to a liquid crystal driving signal.
[0024]On both sides of this liquid crystal light valve 3, the back light source 4 is formed in one side, and the probe 5 for beam-of-light prehension which catches the beam of light which passed this liquid crystal light valve 3 is formed in another side. The beam of light caught with the probe 5 is given to the photometry device 7, for example via the optical fiber 6. As long as an impressed-electromotive-force-transmissivity characteristic is almost the same and the installed position of the probe 5 faces the transmission surface of the liquid crystal light valve 3

in every position, what kind of position may be sufficient as the liquid crystal light valve 3.
[0025]Here, when aimed at the liquid crystal light valve 3 which has a light filter which becomes by the mosaic array of three-primary-colors R, G, and B, a white light source is used as the light source 4, and a spectrometer is used as the photometry device 7. In this case, the data processing device 1 incorporates the luminosity of red and three blue and green wavelength bands, or the data (this expresses transmissivity) of radiant flux (a relation between radiant flux and luminosity called radiant flux x spectral-luminous-efficacy characteristic = luminosity is) from the spectrum data from a spectrometer.
[0026]Hang red and one of blue and green monochromatic filters on the liquid crystal light valve 3, and a white light source is used as the back light source 4, Or when it is going to create each primary signals R and G and the amendment data for B, using red and one of blue and green monochromatic light sources as the back light source 4, without covering a filter over the liquid crystal light valve 3, a luminance meter is used as the photometry device 7. In this case, the luminance data (this also expresses transmissivity) of one of primary signals is incorporated into the data processing device 1.
[0027]The data writing device 9 to the digital memory 8 for amendment (for example, ROM) is connected to the data processing device 1.
It controls so that the data processing device 1 gives the amendment data which performed processing shown in drawing 2 and was obtained eventually to this data writing device 9 and writes in the digital memory 8 for amendment.

[0028](1-2) Explain the processing in the 1st example, next the processing to a certain primary signal which the data processing device 1 performs using drawing 2. Here, drawing 2 (A) shows a main routine, drawing 2 (B) shows the subroutine which shows concrete processing of measurement of an impressed-electromotive-force-transmissivity characteristic, and drawing 2 (C) shows the concrete subroutine which checks the linearity of the characteristic after a compensation process.
[0029]First, the data processing device 1 performs a with an impressed-electromotive-force-transmissivity characteristic [1st] measuring process, after initializing the system concerned (step SP1, SP2). Then, the range of the input voltage to amend is set up based on this measurement result (step SP3). For example, the range from the minimum of input voltage to the maximum which the transmissivity of the liquid crystal light valve 3 changes is set up.
[0030]Then, the data processing device 1 measures the 2nd transmissivity that made input voltage of the set-up range impressed electromotive force (step SP4). Here, by the 1st time and the 2nd time, as mentioned above, the variable ranges of impressed electromotive force differ, and further, since the 2nd measurement is main measurement, the variable step of voltage is also fine.
[0031]Thus, if an impressed-electromotive-force-transmissivity characteristic is acquired, amendment data will be created as it mentions later (step SP5). Here, all of impressed electromotive force, transmissivity, and amendment data are normalized and treated. For example, perform normalization which sets the minimum of impressed electromotive force to 0, and sets the maximum to 1, and. The minimum is normalized to 0, the maximum is normalized to 1, further, also in the amendment data which amends input voltage to impressed electromotive force, the minimum is normalized to 0 and the transmissivity according to it also normalizes the maximum for the input voltage before amendment, and the impressed electromotive force after amendment to 1. In the case of this example, the amendment data obtained by processing of this step is stored in the buffer memory in the data processing device 1.
[0032]If amendment data is obtained, reexamination of the obtained amendment data will be performed. That is, when amendment data is applied, it is checked whether the input voltage (it is not the impressed electromotive force) and transmissivity before amendment are in linear relation (step SP6). By this processing, when amendment data is not appropriate, amendment data is corrected within the confirming processing of this linear relation.
[0033]Thus, if the linear relation of input voltage (voltage before amendment) and transmissivity is obtained, Final amendment data is given to the data writing device 9 to the digital memory 8

for amendment (for example, ROM), and this final amendment data is made to write in the digital memory 8 for amendment with this data writing device 9 (step SP7).
[0034]Next, the measuring process of the impressed-electromotive-force-transmissivity characteristic in step SP2 or SP4 is explained in full detail using drawing 2 (B).
[0035]In this processing, the minimum is first set up as impressed electromotive force (step SP10). Thereby, the liquid crystal driving signal according to this is outputted from the arbitrary waveform generator 2, and transmittance control operation of the liquid crystal light valve 3 is made. Since it is for the 1st measuring process (step SP2) acquiring the range of the input voltage to amend here, this minimum is a value small enough and is the minimum of the range set up in the 2nd measuring process (step SP4).
[0036]Next, it checks that the present object voltage is not the maximum of a time base range (step SP11), and the output data of the photometry device 7 at that time is incorporated (step SP12). That is, the transmissivity to the present object voltage is measured. Since it is for the 1st measuring process acquiring the range of the input voltage to amend also here, this maximum is a value large enough and is the maximum of the range set up in the 2nd measuring process.
[0037]Thus, after measurement of the transmissivity to a certain voltage finishes, it returns to step SP11 which enlarged measuring object voltage by resolution of measurement, and mentioned it above from now (step SP13).
[0038]By repeating the processing loop which becomes at Steps SP11-SP13, If the transmissivity to each voltage from which it differs from the minimum to the maximum resolution of measurement every can be measured and it finishes measuring the transmissivity to maximum voltage, an affirmation result will be obtained in step SP11 and it will return to a main routine (drawing 2 (A)).
[0039]Next, when amendment data is applied, processing of step SP6 which checks whether the input voltage (it is not the impressed electromotive force) and transmissivity before amendment are in linear relation is explained in full detail using drawing 2 (C).
[0040]If this processing is started, the data processing device 1 will set up the after-amendment minimum voltage which amended first the minimum voltage of the input voltage range which it is going to amend using the amendment data corresponding to the voltage as impressed electromotive force (step SP20). Thereby, the liquid crystal driving signal according to this is outputted from the arbitrary waveform generator 2, and transmittance control operation of the liquid crystal light valve 3 is made.
[0041]Next, it checks that the present object input voltage is not the maximum (step SP21), and the output data of the photometry device 7 at that time is incorporated (step SP22). That is, the transmissivity to the object voltage after the present amendment is measured. And an error with transmissivity when there is linear relation judges whether it is in the linear relation to the pressure value before this transmissivity amending by whether it is less than predetermined default value (step SP23).
[0042]If a negative result is obtained by this judgment, it will return to step SP22 which also changed and mentioned above the voltage after the amendment which corrects amendment data according to the error at that time, and is given to the arbitrary waveform generator 2 (step SP24). On the other hand, if an affirmation result is obtained by this judgment, it will return to step SP21 which only prescribed voltage enlarged voltage before amendment used as the present object, and mentioned it above (step SP25).
[0043]Thus, the transmissivity by the voltage which amended each input voltage using the amendment data corresponding to it, It can be checked whether there is any linear relation in input voltage, amendment data can be corrected so that linear relation may be satisfied, when a negative result is obtained, and when the processing to the maximum of input voltage is completed, it returns to a main routine.
[0044](1-3) Explain the preparation method of amendment data, next the preparation method of the amendment data based on processing of step SP5 in full detail, also referring to drawings.
[0045]Drawing 3 is an explanatory view showing the relation between the impressed-electromotive-force-transmissivity characteristic curve normalized about the liquid crystal light valve 3, and an impressed-electromotive-force-transmissivity correction curve. As shown in the

curve C1 of drawing 3, the relation on a serpentine curve between the impressed electromotive force (horizontal axis x) to the liquid crystal light valve 3 and the transmissivity (vertical axis y) in the impressed electromotive force is. As shown the input voltage (the video-signal voltage at the time of the usual display action corresponds) and transmissivity before amendment in the dotted line C2 of drawing 3, in order to consider it as a linearity relation, here (Here, inverse gamma correction is not taken into consideration), Input voltage is amended, and even if the characteristic shown in the curve C1 to the voltage (impressed electromotive force) after amendment is applied, between the original input voltage and transmissivity, it requires making it a linearity relation arise, as shown in the dotted line C2. Here, in the normalized coordinate system, such a correction curve C3 turns into a curve symmetrical with a line to the dotted line C2 at the curve C1. Therefore, what is necessary is to ask for the impressed-electromotive-force-transmissivity characteristic curve C1 first, as mentioned above, and just to search for the inverse characteristic of this curve C1 after that, in order to ask for the correction curve C3. It is amendment data for which the input/output relation of each point on the impressed-electromotive-force-transmissivity correction curve C3 asks. Therefore, if the impressed-electromotive-force-transmissivity correction curve C3 is obtained from the impressed-electromotive-force-transmissivity characteristic curve C1 obtained as a result of measurement, amendment data will be obtained as a result.

[0046]Methods of obtaining the impressed-electromotive-force-transmissivity correction curve C3 from the impressed-electromotive-force-transmissivity characteristic curve C1 include the method of detecting the point of symmetry on a graph, and the method by the approximation of function.

[0047]First, how to detect the point of symmetry on a graph is explained using drawing 3. Now, suppose that its attention was paid at a certain point A on the impressed-electromotive-force-transmissivity characteristic curve C1. And the point B on the dotted line C2 which specifies the distance L and this distance L of this point A over the dotted line C2 in linear relation is searched for. Next, the point D which separated only the distance L from the dotted line C2 through the point B is searched for. The impressed-electromotive-force-transmissivity correction curve C3 is obtained by performing such processing to the all points of the impressed-electromotive-force-transmissivity characteristic curve C1.

[0048]Next, the method by the approximation of function is explained using drawing 4. The details of the method by the approximation of function are indicated by the Japanese-Patent-Application-No. No. 408806 [two to] specification, and the drawing.

[0049]This method is a method of asking for the impressed-electromotive-force-transmissivity correction curve C3 by carrying out the approximation of function of the impressed-electromotive-force-transmissivity characteristic curve C1, and asking for that inverse function. Here, since the impressed-electromotive-force-transmissivity characteristic curve C1 is a sigmoid curve as mentioned above, it is difficult to express by one function. Then, we decided to approximate the center section of the impressed-electromotive-force-transmissivity characteristic curve C1 in a straight line, and to approximate that order by a predetermined function curve.

[0050]Drawing 4 is an explanatory view of such each approximation functions. As shown in this drawing 4, the curved part by the side of an origin of coordinates is expressed with function y=f (x), a center portion is expressed with function y=g(x), and the curved part of a larger value than it is expressed with function y=h(x). The node coordinates of function f(x) and function g(x) are expressed with E (P1, Q1), and the node coordinates of function g(x) and function h(x) are expressed with F (P2, Q2). And we decided to approximate each function f(x), g(x), and h(x) by (1) type, (2) types, and (3) formulas, respectively.

[0051]

y=f(x)=a1 and x^{b1}(1) (a1 and b1 are constants, and x and y are the values of the range of 0<=x<P1 and 0 <=y<Q1, respectively)

y=g(x)=a2 and x+c2 (2) (a2 and c2 are constants, and x and y are the values of the range of P1<=x<P2 and Q1 <=y<Q2, respectively)

$y=h(x)=a3^{(1-x)\ b3}$(3) (a3 and b3 are constants, and x and y are the values of the range of P2 <=x<1 and Q2 <=y<1, respectively)
Thus, when the impressed-electromotive-force-transmissivity characteristic curve C1 is approximated using function f(x), g(x), and h(x), the impressed-electromotive-force-transmissivity correction curve C3, As mentioned above, and as shown in drawing 4, it can approximate using these inverse function $f^{-1}(x)$s, $g^{-1}(x)$, and $h^{-1}(x)$.
[0052]The concrete procedure which asks for the impressed-electromotive-force-transmissivity correction curve C3 from the impressed-electromotive-force-transmissivity characteristic curve C1 obtained by measurement is as follows.
[0053]First, the curve C1 is trichotomized into the 1st curved part, straight-line portion, and 2nd curved part based on the fine coefficient of each point of the impressed-electromotive-force-transmissivity characteristic curve C1, and the coordinates of the division points E and F are caught. The middle points G and H are defined about each of the 1st and 2nd curved parts, and the coordinates are caught. Each coefficient a1 - a3 which specify each approximation-functions f(x), g(x), and h(x), b1, b3, and c2 are calculated. Inverse function $f^{-1}(x)$, $g^{-1}(x)$, and $h^{-1}(x)$ are calculated using this coefficient. The range to which each inverse function $f^{-1}(x)$, $g^{-1}(x)$, and $h^{-1}(x)$ are applied is clarified. And the value after the amendment according to the value of the input value (point of a x direction) is defined about the total range of an input value.
[0054](1-4) According to the effect of the 1st example, therefore the 1st example, the gray-level-correction information according to the impressed-electromotive-force-transmissivity characteristic of the liquid crystal light valve can be created efficiently in a short time, and the gray-level-correction information preparing system of a liquid crystal light valve storable in the digital memory for amendment can be realized.
[0055]The object which creates amendment data with the application of such a system may be every kind of liquid crystal light valve, may be an identical kind, or may be every lot and every product. The effect that creation storing of the amendment data can be carried out efficiently in the case of the latter is a very big effect.
[0056](1-5) Although it presupposed the voltage signal given to the arbitrary waveform generator 2 from the data processing device 1 that gamma correction is not performed in the modification above-mentioned explanation of the 1st example and what creates the amendment data corresponding to the impressed-electromotive-force-transmissivity characteristic of the liquid crystal light valve 3 was shown, It may be made to create the amendment data which performs impressed-electromotive-force-transmissivity amendment and inverse gamma correction simultaneously from the measured impressed-electromotive-force-transmissivity characteristic. For example, inverse-gamma-correction data is beforehand stored in the data processing device 1, and the obtained impressed-electromotive-force-transmissivity amendment data and the inverse-gamma-correction data stored beforehand are compounded, and it may be made to create the amendment data to the digital memory 8 for amendment.
[0057]In the 1st above-mentioned example, although the thing for the liquid crystal light valve 3 for colors was shown, the contents of this example are applicable also to creation storing of the amendment data for the liquid crystal light valve for black and white. Here, it can respond to black and white by applying a white light source as the back light source 4, and applying a luminance meter as the photometry device 7.
[0058]Although what gives the amended voltage signal to the arbitrary waveform generator 2 was shown on the occasion of the check of the once obtained amendment data, amendment data is also given to the arbitrary waveform generator 2, and it may be made to make the arbitrary waveform generator 2 perform a compensation process.
[0059](2) Explain the 2nd example, next the 2nd example system of this invention using a drawing. It differs from the 1st example constitutionally in that this 2nd example equips the system of measurement of the impressed-electromotive-force-transmissivity characteristic with the point and liquid crystal driving circuit between which it is placed by the digital memory for amendment.
[0060]Drawing 5 is a block diagram showing the entire configuration of this 2nd example, and

identical codes are attached and shown in the corresponding point with drawing 1. In drawing 5, the data processing device 1 of this example outputs the voltage signal which is not performing impressed-electromotive-force-transmissivity amendment to the arbitrary waveform generator 3 in which processing stage. It differs from the data processing device in this point and the 1st example.

[0061]The arbitrary waveform generator 3 of this example generates the video signal which has an arbitrary waveform [video section / that] according to the television signal format which has a Horizontal Synchronizing signal and a Vertical Synchronizing signal moreover centering on the voltage signal from the data processing device 1, and gives it to the liquid crystal driving circuit 10. The digital memory 8 for amendment is related and formed in this liquid crystal driving circuit 10, and the liquid crystal driving circuit 10 amends the video signal from the arbitrary waveform generator 3 using the digital memory 8 for amendment, and drives the liquid crystal light valve 3. The amendment data which the data processing device 1 outputted is written in the digital memory 8 for amendment by the data writing device 9.

[0062]Transmittance control of the cell from which the liquid crystal light valve 3 of this example received the drive controlling by the liquid crystal driving circuit 10 unlike the liquid crystal light valve of the 1st example that short-circuited the direction of X and the direction of Y is carried out.

[0063]The back light source 4 in this 2nd example, the probe 5, the optical fiber 6, and the photometry device 7 are the same as that of the 1st example, and omit that detailed explanation.

[0064]Next, the flow of processing in this 2nd example is explained. The fundamental flow is the same as the flow of processing of the 1st example almost.

[0065]First, the data processing device 1 initializes a system. Under the present circumstances, the amendment data of linear relation, therefore the amendment data which does not perform amendment are made to store in the digital memory 8 for amendment. In such the state, the voltage of a video section makes the video signal of prescribed voltage output from the arbitrary waveform generator 2, preliminary measurement of the impressed-electromotive-force-transmissivity characteristic in that prescribed voltage is performed, and preliminary measurement of the impressed-electromotive-force-transmissivity characteristic about the full voltage range is performed by changing this prescribed voltage one by one. In this case, since the amendment data of linear relation is stored in the digital memory 8 for amendment, the liquid crystal driving circuit 10 will drive the liquid crystal light valve 3 with the video signal from the arbitrary waveform generator 2.

[0066]Then, the range of the input voltage to amend is set up based on this measurement result. And the data processing device 1 makes the video signal which set a certain input voltage signal within the set-up limits as the main voltage of a video section output from the arbitrary waveform generator 2, and measures transmissivity, The impressed-electromotive-force-transmissivity characteristic over the whole region of the range set up by transforming an input voltage signal gradually is measured. Amendment of the video signal is not performed in this case, either.

[0067]Thus, when an impressed-electromotive-force-transmissivity characteristic is acquired, the amendment data which created and created amendment data like the 1st example is made to store in the digital memory 8 for amendment. And transmissometry as well as the 1st time and the 2nd transmissometry is performed. In this case, since amendment data is stored in the digital memory 8 for amendment, after the video signal which the arbitrary waveform generator 2 outputted is amended according to the amendment data stored, the liquid crystal light valve 3 is supplied.

[0068]The data processing device 1 checks the validity of amendment data based on the transmissivity measured at this time. If there is amendment data which is not appropriate, it will be corrected, the digital memory 8 for amendment is updated, and the validity of the amendment data after correction is reconfirmed. In being appropriate about a total range, it ends a series of processings.

[0069]Therefore, also in this 2nd example, the same effect as the 1st example can be acquired.

[0070]It is possible to apply to the light valve for black and white also as a modification about this 2nd example, to obtain the synthetic amendment data of impressed-electromotive-force-transmissivity amendment and inverse gamma correction, etc.
[0071](3) Explain the 3rd example, next the 3rd example system of this invention in full detail, referring to drawings. As opposed to the liquid crystal light valve in which this 3rd example is used for projection type displays, such as a liquid crystal projector. Drawing 6 is a block diagram showing the entire configuration of this 3rd example, and drawing 7 is an explanatory view of the installed position of a probe.
[0072]The composition of this 3rd example has the almost same composition as the 2nd example, as shown in drawing 6. However, the point of using the illumination light source 4 as a light source since it is an object for projected types, They are not the point of having the screen 11 which receives the beam of light which penetrated the liquid crystal light valve 3, and a thing limited to the back of the liquid crystal light valve 3 as the installed position of the probe 5 shows drawing 7, If the screen 11 is a reflection type rather and the front face of the screen 11 and the screen 11 are transmission types, the point that the back of the screen 11 is preferred, and the point of applying spectroradiometer as the photometry device 7 differ from the 2nd example.
[0073]as mentioned above -- constitutionally -- some -- a difference -- being certain -- be alike and carry out -- since the flow of processing is the same as that of the 2nd example, the explanation is omitted.
[0074]Also according to this 3rd example, the same effect as the 1st and 2nd examples can be acquired. As a system to the liquid crystal light valve used for a projection type display, it is more suitable than the system of the 1st and 2nd examples.
[0075]It is possible to apply to the light valve for black and white also as a modification about this 3rd example, to obtain the synthetic amendment data of impressed-electromotive-force-transmissivity amendment and inverse gamma correction, etc.
[0076](4) It may be a master for being directly included in a product as the digital memory 8 for amendment in other example above-mentioned systems, and making many digital memories reproduce. For example, it becomes the latter in applying the same amendment data to the liquid crystal light valve of an identical kind.
[0077]
[Effect of the Invention]As mentioned above, according to this invention, the gray-level-correction information preparing system of the liquid crystal light valve which can perform efficiently measurement of the impressed-electromotive-force-transmissivity characteristic of a liquid crystal light valve and obtained measurement of an impressed-electromotive-force-transmissivity characteristic to gray-level-correction information in a short time is realizable.

[Translation done.]

DESCRIPTION OF DRAWINGS

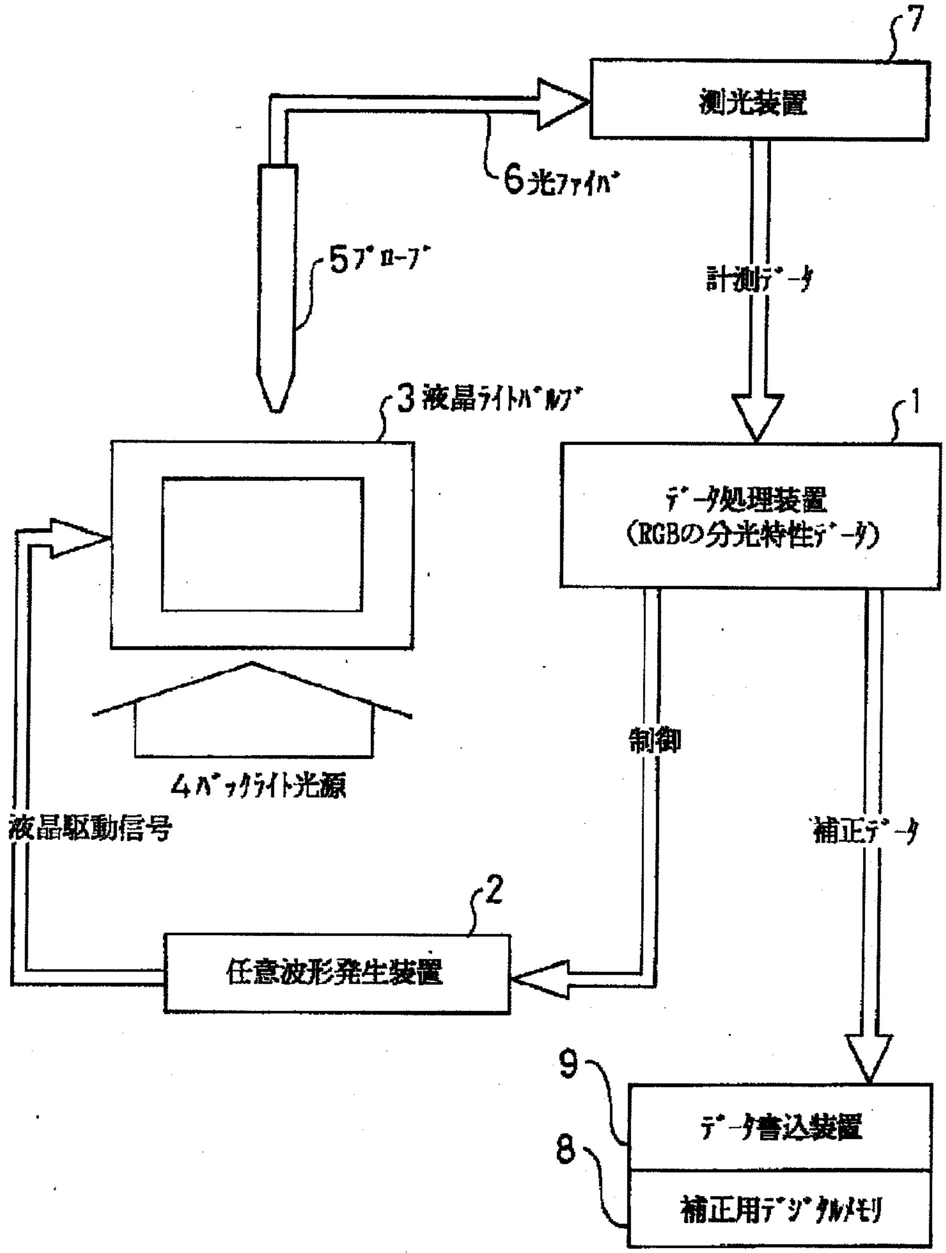
[Brief Description of the Drawings]

[Drawing 1]It is a block diagram showing the composition of the 1st example system.
[Drawing 2]It is a flow chart which shows the flow of processing of the 1st example system.
[Drawing 3]It is an explanatory view (the 1) of the preparation method of amendment data.
[Drawing 4]It is an explanatory view (the 2) of the preparation method of amendment data.
[Drawing 5]It is a block diagram showing the composition of the 2nd example system.
[Drawing 6]It is a block diagram showing the composition of the 3rd example system.
[Drawing 7]It is an explanatory view of the installed position of the probe for light-receiving of the 3rd example system.
[Description of Notations]
1 [-- A light source, 5 / -- The probe for light-receiving, 6 / -- An optical fiber, 7 / -- A photometry device, 8 / -- The digital memory for amendment, 9 / -- A data writing device, 10 / -- A liquid crystal driving circuit, 11 / -- Screen.] -- A data processing device, 2 -- An arbitrary waveform generator, 3 -- A liquid crystal light valve, 4

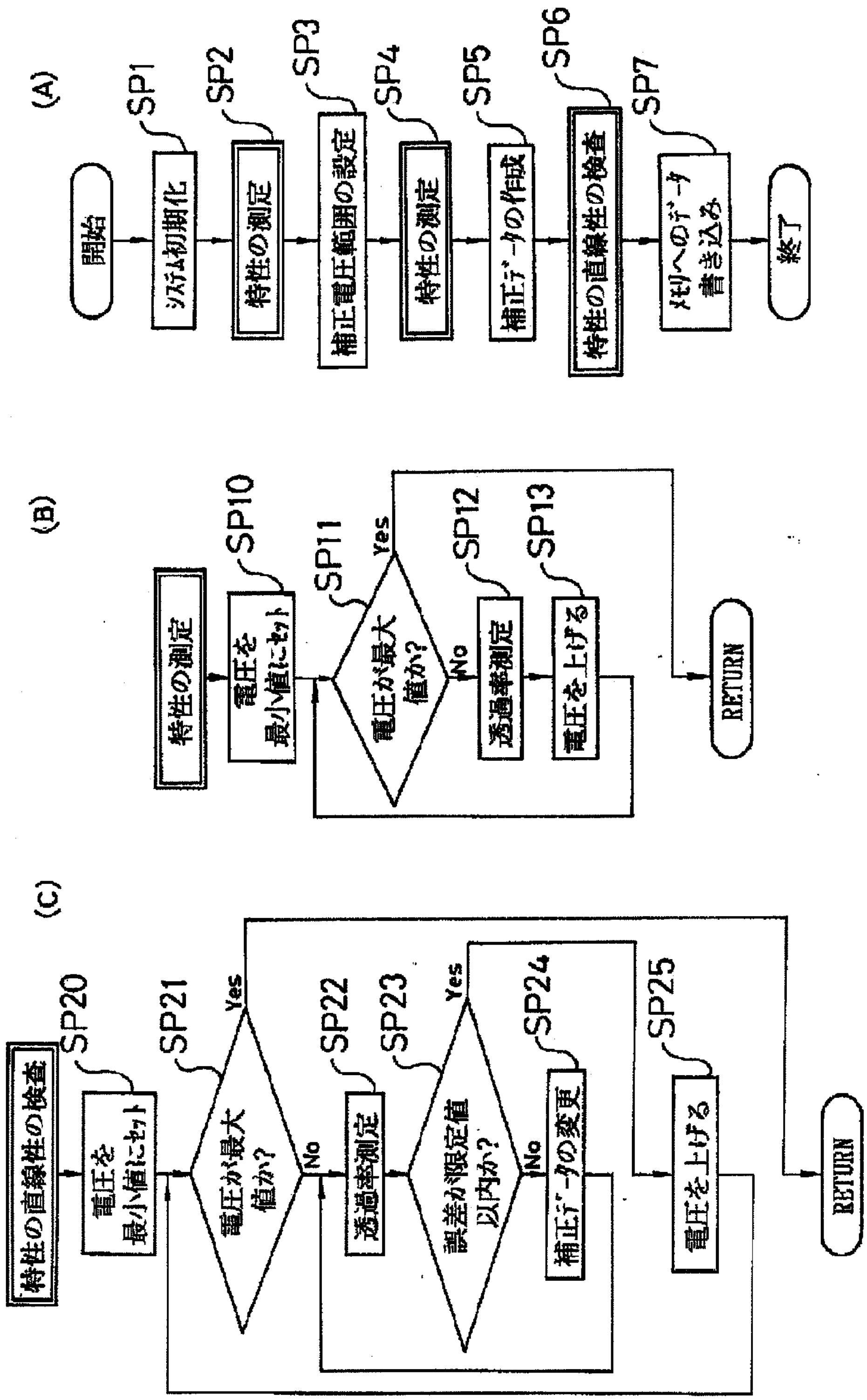
[Translation done.]

DRAWINGS

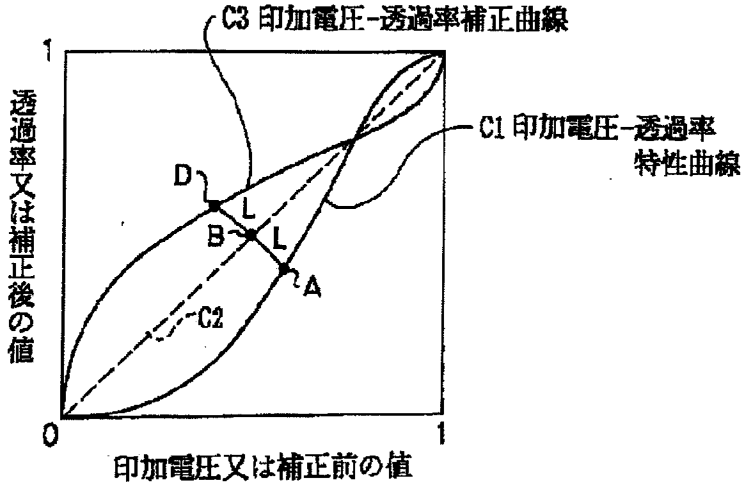
[Drawing 1]


7
測光装置
6光ファイバ
5プローブ
計測データ
3液晶ライトバルブ
1
データ処理装置
（RGBの分光特性データ）
4バックライト光源
制御
補正データ
液晶駆動信号
2
任意波形発生装置
9
データ書込装置
8
補正用デジタルメモリ

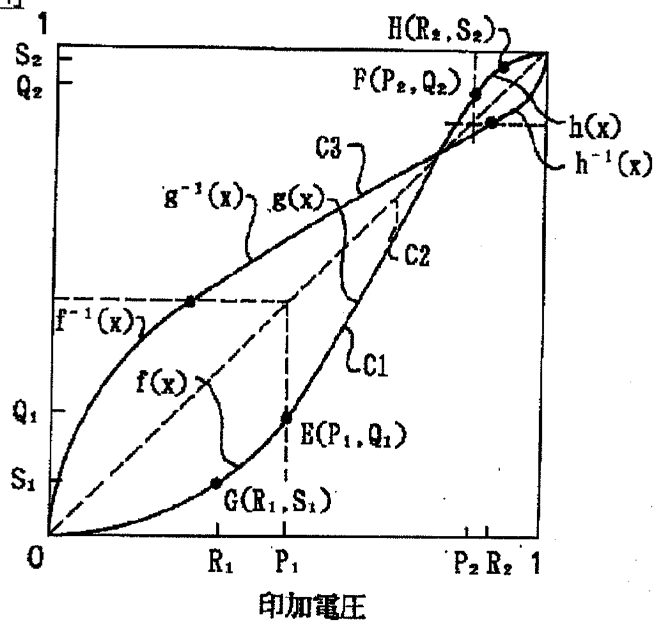
[Drawing 2]


(A)
開始
SP1
ｼｽﾃﾑ初期化
SP2
特性の測定
SP3
補正電圧範囲の設定
SP4
特性の測定
SP5
補正ﾃﾞｰﾀの作成
SP6
特性の直線性の検査
SP7
ﾒﾓﾘへのﾃﾞｰﾀ書き込み
終了
(B)
特性の測定
SP10
電圧を最小値にｾｯﾄ
SP11
電圧が最大値か?
Yes
No
SP12
透過率測定
SP13
電圧を上げる
RETURN
(C)
特性の直線性の検査
SP20
電圧を最小値にｾｯﾄ
SP21
電圧が最大値か?
Yes
No
SP22
透過率測定
SP23
誤差が限定値以内か?
Yes
No
SP24
補正ﾃﾞｰﾀの変更
SP25
電圧を上げる
RETURN

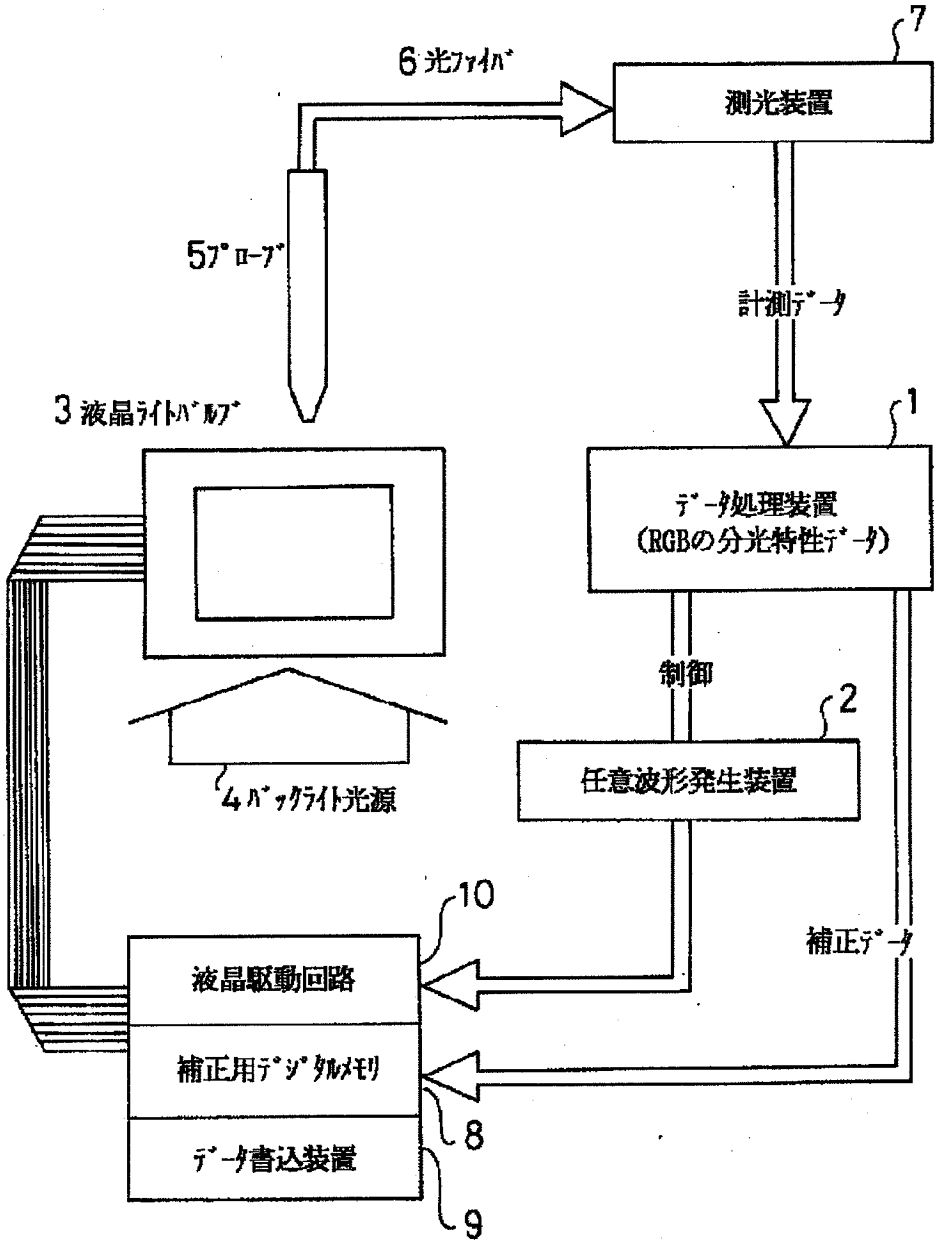
[Drawing 3]



[Drawing 4]

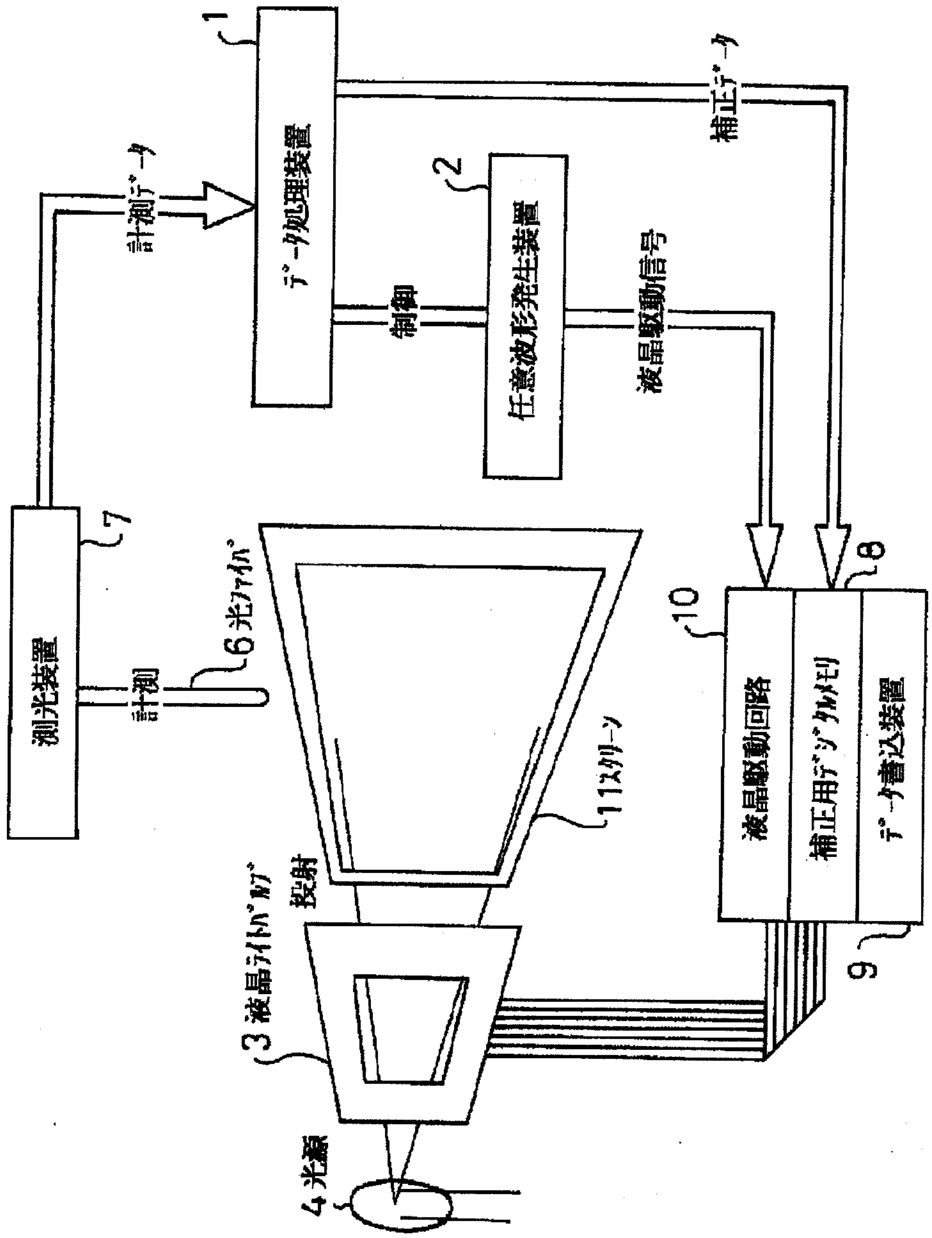


[Drawing 5]

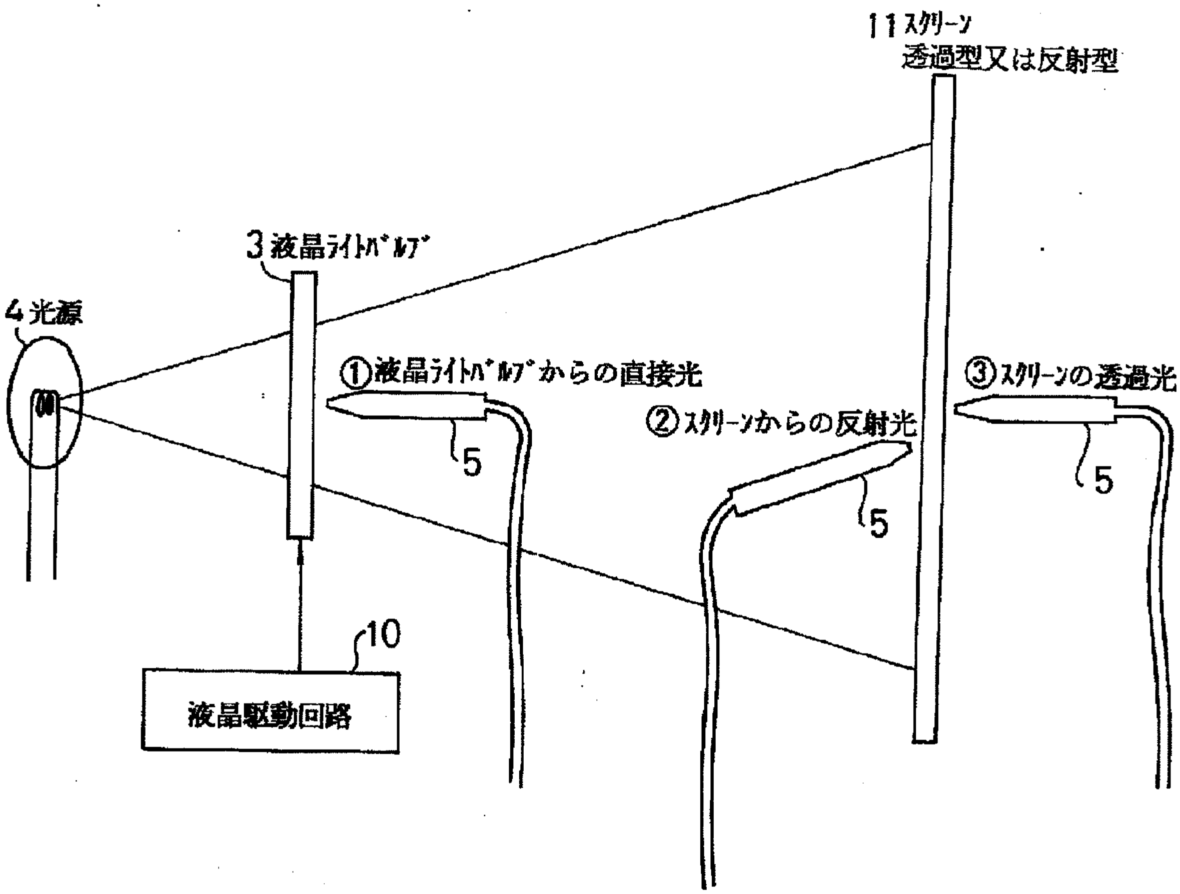


7
6 光ファイバ
測光装置
5プローブ
計測データ
1
3 液晶ライトバルブ
データ処理装置
(RGBの分光特性データ)
制御
2
4 バックライト光源
任意波形発生装置
10
補正データ
液晶駆動回路
補正用デジタルメモリ
8
データ書込装置
9

[Drawing 6]


1
データ処理装置
2
任意波形発生装置
計測データ
制御
液晶駆動信号
補正データ
7
測光装置
計測
6 光ファイバ
11スクリーン
投射
3 液晶ライトバルブ
4 光源
10
液晶駆動回路
補正用デジタルメモリ
データ書込装置
8
9

[Drawing 7]



[Translation done.]